


TECHNICAL SPECIFICATION
 FOR
 FURNISHING, INSTALLATION AND TESTING
 OF
 EXPANSION TYPE CONCRETE ANCHORS
 FOR THE
 CONSUMERS POWER COMPANY
 MIDLAND PLANT, UNITS 1 AND 2
 MIDLAND, MICHIGAN

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No.	DATE	REVISIONS	BY	CHK	APPD
8	2-5-77	Revised as noted on facing sht; Inc SCN 8009 & 8010 ^{MAR/LAD}	DAE	[Signature]	[Signature]
7	10-2-76	Rev as Noted on Facing Sheet, Incorporated SCN 8005, 8006, 8007, and 8008 ^{MAR/LAD}	DAE	[Signature]	[Signature]
6	7-20-76	Rev as noted on facing sht, Inc SCN 8002, 8003, 8004 ^{MAR/LAD}	DNE	[Signature]	[Signature]
5	3-3-76	Revised as Noted on Facing Sheet. Incorporated SCN 7003 & 8001 ^{MAR/LAD}	DNE	[Signature]	[Signature]
4	3-21-77	Revised as noted on facing sheet. Incorporated SCNs 7001 and 7002 ^{MAR/LAD}	[Signature]	[Signature]	[Signature]
3	3-29-77	Revised as noted on facing sheet; Inc. SCN 6006 ^{MAR/LAD}	[Signature]	[Signature]	[Signature]
2	11-17-76	Revised as noted on facing sheet. Inc. SCNs 6001, 6002, 6003, 6004 for M-151 Substances	[Signature]	[Signature]	[Signature]
1	7-1-76	Rev. as Noted on Facing Sheet Inc. SCNs C-6001, C-6002	[Signature]	[Signature]	[Signature]
0	3-23-77	Issued for Use	[Signature]	[Signature]	[Signature]
ORIGIN		 CONSUMERS POWER COMPANY MIDLAND PLANT, UNITS 1 AND 2 MIDLAND, MICHIGAN	JOB No. 7220		
BAPC			SPEC DES GUIDE No.		F.V.
			7220-C-305(0)		

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5	5-8-78	Revised shts 1, 11, 3, 6, & C-4	J.D. [unclear]								
4	7/21/77	Rev shts 1, 11, 3, 6, B-1, C-4, E-2	[unclear]	8	7/21/77	Rev shts 1, 11, 7 & 8	DAZ	[unclear]			
3	3/29/77	Revised shts 1, 11, 11, 5, 6 Add App. E	[unclear]	7	10/2/78	Rev shts 1, 11, 11, 1 thru 11; A-1; B-1; C-1 thru C-6; D-1 and D-2; E-1 thru E-3	DAZ	[unclear]			
2	11-17-76	Revised sheets 1, 11, 11, 12 thru 6, 8, 9, 11, C-2, C-3, C-4, C-5	[unclear]	6	7/20/78	Rev shts 1, 11, 11, 3-5, 3-11; App C, rev page C-3, added page C-6.	DAZ	[unclear]			
1	7/6/76	Revised all sheets, added C-1 thru C-5, D-1 & D-2, Inc. SCR C-6001 & SCR C-6002	ADZ								
0	4-13-76	Issued for Use	[unclear]								
NO	DATE	REVISIONS	BY	CHECK'D	APPR'D	NO	DATE	REVISIONS	BY	CHECK'D	APPR'D

FACING SHEET

MIDLAND PLANT UNITS 1 & 2
 Furnishing, Installation and Testing of
 Expansion "Type" Anchors
 Consumers Power Company

JOB No. 7220
 7220-C-305 (0)
 Sheet 11



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FURNISHING, INSTALLATION, AND TESTING

OF

EXPANSION TYPE CONCRETE ANCHORS

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FURNISHING, INSTALLATION, AND TESTING

OF

EXPANSION TYPE CONCRETE ANCHORS

1.0 SCOPE OF WORK

The work includes the furnishing, installation, inspection, testing, and documentation requirements of expansion type concrete anchors.

2.0 APPLICATIONS

ASME Section III Classes I, II, and III piping and hanger critical shall be shown on the Piping Class Summary Sheet. The pipe whip restraints shall be as shown on design drawings.

2.1 Expansion anchors may be used for attaching the following items as shown in Table 2.1.

2.2 Unless otherwise specified on the design drawings or approved by project engineering, expansion anchors shall be wedge or stud type.

2.3 Stud anchor and drop-in anchor substitution

2.3.1 When stud anchors and drop-in anchors are substituted for each other, the field engineer shall ensure that the following requirements are met.

- a. The anchor which is being used shall have the tension and shear capacities at least as large as the anchor which it is replacing.
- b. The design load of the drop-in anchors must be reduced by the amount indicated in Table 3.2 to correspond to the same center-to-center spacing (and minimum edge distance) for the same diameter stud anchor.



Application	Category	Limitations on Application	Qual	Ins	Yes/No
Pipe Supports and High Energy Pipe Whip Restraints for the Following Piping Classifications 1) ASME Section III Classes 1,2,3 2) ANSI B31.1.0 3) ANSI B31.1	Q	See Note (1)	Yes	Yes	Yes
	Hanger Critical and High Energy Pipe Whip Restraints Non-Q	See Note (1)	Yes	Yes	No
	Other Non-Q				
Supports for Electrical Cable Trays and H&V Ducts	Q	None	Yes	Yes	Yes
	Non-Q	None	Yes	Yes	No
Supports for Equipment	Q	Limited to equipment weighing less than 10 kips (2)	Yes	Yes	Yes
	Non-Q	None	Yes	Yes	No
Attachment to (Filled) Concrete Block Walls	Q and Non-Q	See Note (3)	Yes	Yes	Yes
Supports for Structural and Miscellaneous Metal Items Such as Platforms, Ladders, Handrails, Supports of Miscellaneous Electrical and Instrumentation Items	Q	Limited to total load of 10 kips	Yes	Yes	Yes
	Critical Support (design for seismic loading) Non-Q	None	Yes	Yes	No
	Other Non-Q except as noted below	None	Yes	No	No
	Applications such as lighting panels, junction boxes, conduit, instrument tubing and inter-communication equipment (See Section 3.2)	None	No	No	No

does not exceed 15 kips per hanger except as noted below:

- a) Expansion anchors shall not be used for Class I piping over 2-1/2 inches in diameter.
 - b) Expansion anchors shall not be used for Class II piping over 8 inches in diameter.
 - c) Expansion anchors shall not be used for piping systems and anchor points as listed in Appendix D.
- (2) Expansion anchors shall not be used for reciprocating equipment.
- (3) Expansion anchors shall not be used to attach Q items and piping to block walls. Use of expansion anchors on concrete filled block walls shall be limited to supporting light loads for non-Q electrical, mechanical, architectural, or instrumentation applications.

Any deviation from the use of expansion anchors described above must be approved by the project engineer/Contractor on a case-by-case basis. Any conflict between this specification and hanger detail drawings shall be referred to the project engineer/Contractor for resolution.

3.0 MATERIALS

- 3.1 Concrete expansion anchors shall be limited to the following types:

Phillips Wedge or Sleeve Anchor -
Phillips Drill Co.
Hilti Kwik-Bolt Stud Anchor -
Hilti Fastening Systems, Inc.
Molly Parabolt (Stud) Anchor -
USM Corporation, Construction Products Div.
Hilti-HDI Drop-In Anchor (HDI Drop-In Anchor) -
Hilti Fastening Systems, Inc.

instrumentation, and structural applications as indicated in Table 2.1.

Phillips self-drilling series S,
Multiset drop in anchor series MS, or
Nondrilling anchors series J

Material certification is not required for these anchors.

3.3 Material Documentation Requirements

The manufacturer/Subcontractor shall submit a certificate of compliance for the materials used for the studs and nuts with each lot of anchors stating that the anchors conform to the requirements of the following materials:

AISI 11L41, Stud Material or
AISI 1144, Stud Material

A307, Nut Material or
A325, Nut Material

AISI 12L14 - HDI Drop-In Anchors

Other types of concrete expansion anchors may be used, provided that sufficient data is available to justify their use, subject to the project engineer's/Contractor's approval.

4.0 INSTALLATION

Installation of the expansion concrete anchors shall be performed in accordance with the requirements of Table 2.1. The installers shall be qualified to perform this work by the project field engineer/Subcontractor.

4.1 Expansion anchors shall be installed in concrete which has been in place for more than 28 days. Expansion anchors shall not be installed in concrete block walls except as noted in Table 2.1.

4.2 Holes for expansion bolts shall be drilled in accordance with manufacturer's installation recommendations except as specified herein.







- x. Unless diamond core bits are used, the bit shall be removed upon meeting the rebar. Diamond core bits shall be used to cut the rebars and to drill the hole beyond the reinforcing bar such that the whole wedge portion of the anchor can be expanded behind the rebar (see Figure 2). The tolerances for the drills shall be as recommended by the expansion anchor manufacturer.
- 4.5 Expansion anchors which interfere with reinforcing steel shall be installed in accordance with Appendix E. 
- 4.6 After reaching the required depth, the concrete dust shall be removed from the hole.
- 4.7 Expansion anchors shall be installed in accordance with the manufacturer's recommendations and as shown below.
- 4.8 Expansion anchors (except HDI drop-in anchors) shall be seated and expanded by applying the torque as determined by onsite testing (See Table 4.1). A manually operated calibrated torque wrench or a power operated impact torque wrench shall be used to measure the torque. 

- 4.9 Welding to expansion anchors shall not be permitted.
- 4.10 The nut shall be fully engaged on the expansion bolt. 

TABLE 4.1

(For wedge and stud type anchors)

Anchor Diameter Inches	Torque at Installation ft-lbs Threads not lubricated (1)	 Test Torque (After Installation) Ft. Lbs.	Test Load Kips	Min. Turns of nut required in torque range	Min. Embedment Inches	Min. c/ Spacing Inches
1/4	5 - 10	5	0.5	-	1-1/8	3
3/8	25 - 35	20	1.0	-	1-5/8	4
1/2	35 - 55	30	2.0	2	2-1/4	5
5/8	130 - 160	80		2	2-3/4	6
5/8	130 - 160	80		2	4	6
3/4	240 - 270	135		3	3-1/4	7-1/2
3/4	240 - 270	135		3	5	7-1/2
7/8	275 - 325	165		3	4	9
7/8	275 - 325	165		3	5-1/2	9
1	425 - 475	240		3	4-1/2	10
1	425 - 475	240	3	6	10	

- (1) These values give a torque range, which was arrived at by testing anchors for the different concrete strengths used on the job (for 1/2", 5/8", 3/4", 7/8" and 1" expansion anchors only).
- (2) If the maximum torque value is attained, the minimum number of turns is not applicable.
- (3) The minimum spacing and minimum edge distance may be reduced upto 50% with prior approval of Project Engineering.
- (4) Use greater minimum embedment length for installation, unless noted otherwise on the design documents or as approved by Project Engineering.



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inspected for correct installation. If inspection reveals that an installed anchor does not conform to the requirements of Article 4.0, that anchor shall be tested in accordance with Section 6.0, either relocated as permitted by the design and the requirements of this specification, or removed and replaced by another anchor. Mislocated anchors may be left in place provided that they do not interfere with other work. Acceptability by testing of mislocated anchors is not permitted.



6.0 TESTING

6.1 Testing Frequency

- 6.1.1 One out of each lot of 10 expansion anchors installed for anchors other than 3/8-inch and 1/4-inch diameter and one out of each lot of 20 expansion anchors installed for anchors of 3/8-inch and 1/4-inch diameter, shall be tested in accordance with the requirements of Section 6.2. Test anchors shall be selected at random so that they are representative of the group in which they are located and of the installation conditions.
- 6.1.2 If the test anchor satisfies the acceptance criteria of Section 6.3, all anchors of that lot shall be deemed acceptable.
- 6.1.3 Should the test anchor fail to satisfy any one of the acceptance criteria, three additional anchors of the same lot shall be tested in accordance with Section 6.2.
- 6.1.4 Should all of the additional test anchors satisfy the acceptance criteria, all remaining anchors in that lot shall be deemed acceptable.
- 6.1.5 Should any of the additional test anchors fail, all anchors in that lot shall be tested.

installers. Hilti-MDI drop-in anchors shall be tested using the tensioner testing method. Test anchors, selected in accordance with the provisions of Section 6.1 above, shall be tested by one or both of the following methods:

6.2.1 Torque Testing Method

Test the installed expansion anchor with a calibrated manually operated or a power-operated impact torque wrench. The anchor shall meet the acceptance criteria of Section 6.3.

6.2.2 Tensioner Testing Method

Test the installed expansion anchor with a tensioner. For expansion anchors use the test loads shown in Table 4.1, and for drop-in anchors use the test loads shown in Table 3.2 of Appendix C. The testing equipment shall be supported so that the load will be distributed outside a circle that has a minimum diameter of four (4) times the minimum embedment of the anchor.

6.3 Acceptance Criteria

An installed anchor shall be considered acceptable if it meets the applicable testing criteria of Table 4.1 or Table 3.2 of Appendix C, and if during testing the concrete did not break out, the anchor did not break, distort, or deform; and the anchor did not slip excessively or become loose. The anchor shall be termed "slip excessively" as follows:

6.3.1 Torque Testing Method

The nut will rotate with less than the applicable test torque applied per Table 4.1.

6.3.2 Tensioner Testing Method

The washer can be rotated by hand when the load is fully applied.

as specified. Damaged concrete must be repaired.

7.1 Failure Due to Concrete Breakout

7.1.1 Replace the expansion anchor with the embedment depth obtained beyond the breakout depth.

7.1.2 Damaged concrete shall be repaired in accordance with the requirements of Article 17.0 of Specification 7220-C-231. Damaged concrete shall be chipped to sound concrete prior to reinstallation of anchors. Concrete shall be repaired after reinstallation of anchor.



7.2 Failure Due to Anchor Breakage, Slippage or Loosening

If the anchor breaks, distorts, or deforms, it shall be replaced with another anchor, or the hole shall be redrilled and a larger size anchor installed, if the integrity of surrounding concrete has not been disturbed. If the anchor fails by slippage or loosening, the anchor shall be retorqued and retested.

8.0 QUALITY ASSURANCE

8.1 General

For items which require inspection, testing, and documentation as shown in Table 2.1, the Subcontractor's/Contractor's quality assurance practices shall be followed to ensure compliance with the requirements of this specification.



8.2 Documentation

Requirements listed below shall be documented.



8.2.1 Test Inspection Record

Anchor test inspection records shall be maintained. These records shall contain, as a minimum, the following information:

- c. Test results
- d. Inspector's name
- e. Date of Test

8.2.2 Failed Anchor Report:

The following additional information shall be required for test anchors which failed:

- a. Exact location of failed anchor
- b. Mode of failure and probable cause of failure
- c. Repair steps taken
- d. Inspector's name
- e. Date of test

8.2.3 All documentation and records shall be retained for inclusion in the quality control files.

9.0 OTHER INFORMATION REQUIREMENTS

This section deals with information collection and is not to be considered as a part of the Quality Assurance program.

9.1 Summary report on tests shall be completed and submitted by Subcontractor monthly to the project engineer/Contractor. These reports shall contain the following data:

- 9.1.1 Number of anchors installed
- 9.1.2 Number of anchors tested
- 9.1.3 Number of failed anchors
- 9.1.4 Mode of failure and probable cause of failure



9.2

If failure frequency of anchors is less than 0.5%, the summary report period may be increased to 3 months subject to approval by the project engineer/Contractor.



FIGURE 1 - WHEN NO REBARS ARE ENCOUNTERED

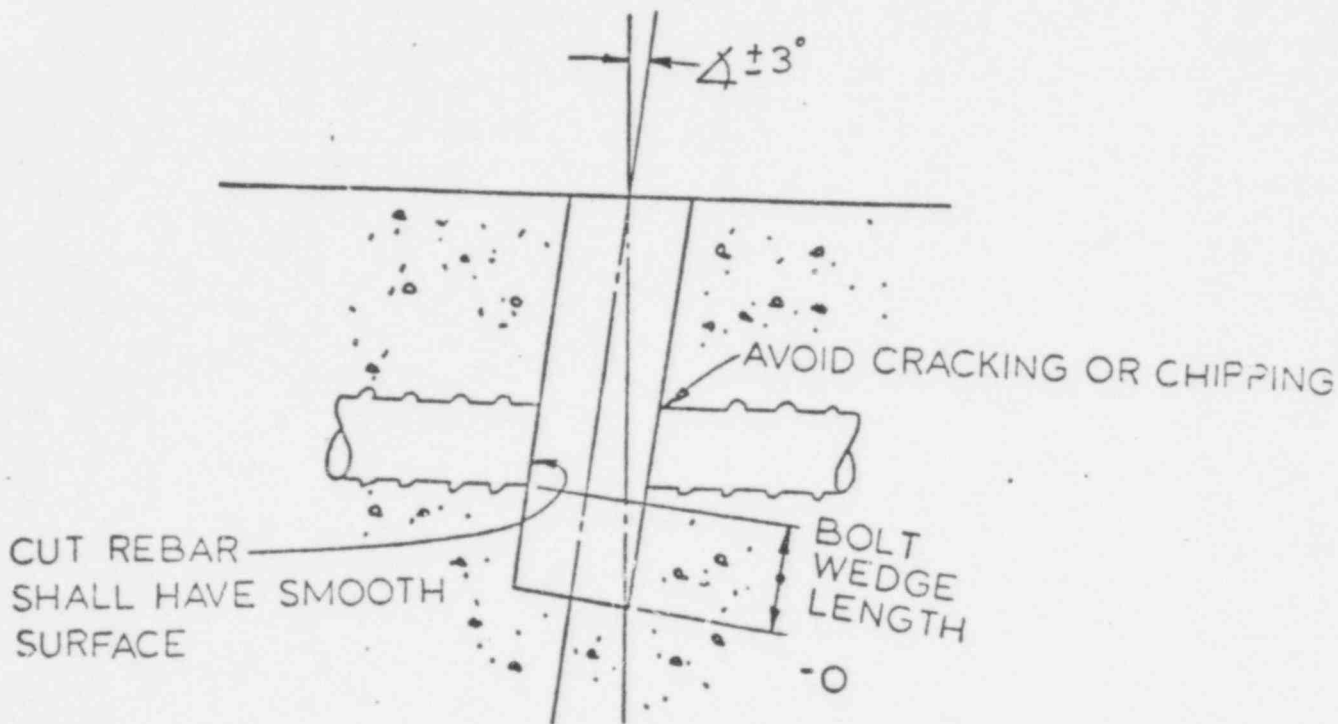


FIGURE 2 - WHEN REBAR IS CUT

- Alternative shall be determined by the Project Field Engineer
- a) Bolt Expansion Wedge Shall Not Be Located Inside Rebar
 - b) Use Special Order Long Bolts
 - c) Relocate Hole



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QUALITY ASSURANCE REQUIREMENTS FOR
PURCHASE OF
Q-LISTED EXPANSION TYPE CONCRETE ANCHORS

- 1.0 The Seller/Subcontractor shall establish and maintain an effective Quality Assurance Program which will meet the applicable requirements of Specification G-23 to ensure that all materials and workmanship furnished hereunder conform to specifications.
- 2.0 The Buyer shall have free access to all work and shall have the authority to stop work or reject shipment if the specification requirements including those for documentation, have not been fulfilled.
- 3.0 The Seller/Subcontractor shall furnish documentation in accordance with the specifications as summarized and directed by Form G-321-D. To complete Form G-321-D, the Seller/Subcontractor shall check in Column 8 which documents are being transmitted and shall sign Line 21. The Seller/Subcontractor shall fill in Lines 18 through 20 as applicable. Entries such as N/A (not applicable) and "See attached sheets" are permissible. The completed G-321-D form is then used for a cover sheet as directed on the back of the form.

Attachments:

1. Form G-321-D, Engineering and Quality Verification Document Requirements, Rev. 2 | 
2. Specification G-23, General Requirements for Supplier Quality Assurance Programs, Rev. 5
3. Quality Assurance Program Element Data Sheet 1, Rev. 1 | 

1. Document Category Number	2. Specification Paragraph Reference	3. Kind of Copies	ENGINEERING DOCUMENTS				QUALITY VERIFICATION DOCUMENTS						12. Remarks
			4. Quantity Required		5. Prior Approval Required		6. Quantity Required for Release	7. Distribution Code	8. Supplier Conforms Check	9. Inspection Release	10. Engineering Review	11. Field O/E Check In	
			Initial	Final	Yes	No							
10.1		Reproducible	1	1	X								Package of sample Quality Verification documents showing format and typical content.
		Microfilm											
17.4(V)	3.1	Reproducible		N/A		1	a						
		Microfilm											
		Reproducible											
		Microfilm											
6.0	Appx B G-23	Reproducible	1	2									
		Microfilm			X	N/A							
		Reproducible											
		Microfilm											
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		Reproducible											
		Microfilm											

13. Supplier's Order No.	14. Supplier's Part No.	15. Supplier's Part Name	16. Quantity
17. Buyer's Req. Item No.	18. Buyer's Line/Equip. Tag or Code No.	19. Buyer's Part Name	20. Traceability


21. Supplier's Conformance Statement: We certify that the listed work and required documents meet the requirements of the procuring documents. Supplier: _____ Signature _____ Title _____ Date _____

22. Inspection Release Statement: Work was released based on satisfactory completion of inspection and review of documentation. Authorized Deviations: YES, Noted under 12, Remarks NONE. Bechtel Inspector: _____ Signature _____ Date _____

23. Engineering Review Statement: The Quality Verification Documents submitted to Engineering with this form have been reviewed for conformance to the specified requirements and are acceptable. Engineer: _____ Signature _____ Date _____

24. QCE Check In Statement: This form and the Quality Verification Documents referenced herein have been received and their relationship to the hardware items verified. CONTROL NO. _____ FILE NO. _____ QCE: _____ Signature _____ Date _____

After QCE Check in Distribute to: Procurement Manager, Field Office Manager, Material Supervisor

 G 321 D AA REV 7 5/74	MIDLAND PLANTS - UNITS 1 & 2 CONSUMERS POWER COMPANY	JOB NO. 7220 PROJECT NUMBER 7220-C-305 (C)
	ENGINEERING AND QUALITY VERIFICATION DOCUMENT REQUIREMENTS	

REPRODUCTION OF THIS FORM IS AUTHORIZED. QUALITY VERIFICATION DOCUMENT TRANSMITTAL - REPRODUCE THIS SIDE ONLY

Appendix B - Attachment 1

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GENERAL INFORMATION: Engineering (E) and Quality Verification (V) Documents are identified by Category number (1) title in section H, below.

USE: A copy of the front of this form shall be completed by the supplier and provided to the Buyer's/Contractor's Inspector along with the applicable Quality Verification Documents for his review prior to release of the unit(s).

DISTRIBUTION: All Engineering (E) Documents are to be sent to the Project Engineer at the address shown below (Code a).

When inspection release is completed, the Verification (V) Documents are to be distributed to the respective addresses shown below in accordance with the distribution code specified in Column 7. A copy of the completed Form G-321-D must accompany each "package" of Verification Documents to its destination. Also, a copy of completed Form G-321-D is to be included with the hardware shipment and a copy sent separately to the Project Field Quality Control Engineer at the jobsite.

Code a.
 Bechtel Power Corp.
 P.O. Box 2167
 Midland, Michigan 48640
 Attn: Project Field Engineer

Code b. With hardware shipment
 Bechtel Power Corp.
 3500 E. Miller Road
 Midland, Michigan 48640

Code z.
 Bechtel Power Corp.
 P. O. Box 2167
 Midland, Michigan 48640
 Attn: Quality Control Engineer

DEFINITIONS OF TERMS: (See also Document Category Definitions G-321-SUP A)

- Supplier - This is a generic term and is synonymous with the terms seller, vendor, contractor, sub-contractor, sub-supplier, etc.
- Reproducible - can be legibly duplicated by either microreproduction or electronic dry process.
- Microfilm - 35mm microfilm conforming to the requirements of the procurement documents. When not specified, supplier shall submit his standard for approval.
- Prior Approval Required - Bechtel approval required prior to use of documents in the design, fabrication, installation, or other work process.
- Initial - the first submittal of a document in accordance with the schedule mutually agreed to by the Buyer and the supplier.
- Final - the submittal that reflects the resolution of review comments, or the complete submittal required. Both are to be accepted prior to rendering final payment. Drawings submitted as Final must be full size reproducible made from original document. Adjacent to the title block, each drawing must be certified and show Buyer's job title, job number, purchase order number, line, equipment, tag or code number, and the manufacturer's serial number(s).
- Certified - the dated Signature and Title of an authorized and responsible employee of the supplier.
- N/A - Not applicable - can be used for individual entries, columns and lines by Project engineering, and for individual entries by the supplier.

F. BECHTEL ENTRY INSTRUCTIONS

Entry No.	Information Required
1	Enter Document Category Number.
2	Enter Specification paragraph reference.
3	Make no entry. Relates to kind of copies required.
4	Enter the number of each kind of copy for "initial" or "final" submittals of Engineering Documents.
5	Enter approval requirement by X under "Yes" or "No" column.
6	Enter the number of each kind of copy of Quality Verification Documents required for release of the item or installation.
7	Enter Quality Verification Document distribution code letter in accordance with paragraph D above.
8	Make no entry. For supplier use only.
9	Bechtel Inspector to complete upon release. Sign on line 22.
10	Enter Bechtel Engineering review confirmation. Sign on line 23.
11	Bechtel QCE to complete check-in. Sign on line 24.
12	Enter remarks as appropriate.

G. SUPPLIER ENTRY INSTRUCTIONS

Entry No.	Information Required
8	Enter number of pages of each type of Quality Verification Documents being submitted for the unit(s) being released. Sign Statement of Conformance on line 21.
12	Enter remarks as appropriate. When a deviation has occurred, reference the deviation(s) and Buyer/Contractor's authorization in this column, and include the authorization document(s) in the Verification Document Package.
13, 14, 15	Enter information as required.
16	Enter the numbers of units covered by the Quality Verification Documents being submitted. For each requisition item no. being released provide a separate copy of this completed form and the supporting Quality Verification Documents.
17, 18, 19	Enter information as required.
20	Enter identification number(s) traceable to the unit(s) being released, e.g. serial no., heat no. of major component, cable reel no. or other unique designator.

H. DOCUMENT CATEGORY NUMBERS: Engineering (E) and Quality Verification (V) Document Requirements as entered in Column 1, and defined in G-321-SUP A Document Category Definitions. For details, see specification paragraph(s) referenced in Column 2.

1.0 DRAWINGS (E)	10.2 Typical Material Used	20.0 RT - RADIOGRAPHIC EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V)
1.1 Outline Dimensions, Services and Foundation/Mounting Details	11.0 MATERIAL DESCRIPTION (E)	21.0 MT - MAGNETIC PARTICLE EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V)
1.2 Assembly Drawings	12.0 WELDING PROCEDURES AND QUALIFICATIONS (E), AND VERIFICATION REPORTS (V)	22.0 PT - LIQUID PENETRANT EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V)
1.3 Shop Detail Drawings	13.0 WELD ROD CONTROL PROCEDURES (E), AND VERIFICATION REPORTS (V)	23.0 EDDY CURRENT EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V)
1.4 Wiring Diagrams	14.0 REPAIR PROCEDURES (E), AND MAJOR REPAIR VERIFICATION REPORTS (V)	24.0 PRESSURE TEST - HYDRO, AIR, LEAK, BUBBLE OR VACUUM TEST PROCEDURE (E), AND VERIFICATION REPORTS (V)
1.5 Control Logic Diagrams	15.0 CLEANING AND COATING PROCEDURES (E), AND VERIFICATION REPORTS (V)	25.0 INSPECTION PROCEDURE (E), AND VERIFICATION REPORTS (V)
1.6 P & IDs	16.0 HEAT TREATMENT PROCEDURES (E), AND VERIFICATION REPORTS (V)	26.0 PERFORMANCE TEST PROCEDURES (E), AND VERIFICATION REPORTS (V)
2.0 PARTS LIST AND COST (E)	17.0 CERTIFIED MATERIAL PROPERTY REPORTS (V)	26.1 Mechanical Tests
3.0 COMPLETED BECHTEL DATA SHEETS (E)	17.1 MTR (Certified Material Test Report)	26.2 Electrical Tests
4.0 INSTRUCTIONS (E)	17.2 Impact Test Data	27.0 PROTOTYPE TEST REPORT (E & V)
4.1 Erection/Installation	17.3 Ferrite Data	28.0 SUPPLIER SHIPPING PREPARATION PROCEDURE (E)
4.2 Operating	17.4 Material Certificate of Compliance	
4.3 Maintenance	17.5 Electrical Property Reports	
4.4 Site Storage and Handling	18.0 CODE COMPLIANCE (V)	
5.0 SCHEDULES - ENGINEERING AND FABRICATION/ECTION (E)	19.0 UT - ULTRASONIC EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V)	
6.0 QUALITY ASSURANCE MANUAL PROCEDURES (E)		
7.0 SEISMIC DATA REPORT (E)		
8.0 ANALYSIS AND DESIGN REPORT (E)		
9.0 ACOUSTIC DATA REPORT (E)		
10.0 SAMPLES (E)		
10.1 Typical Quality Verification Documents		

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(E) - Engineering documents - This term includes procedures, drawings, specifications, QA plans, prototype qualification test reports, and other similar documents that require Bechtel approval prior to fabrication, or prior to use of the document in the design, fabrication, installation, or other work process. The term is also applied to price lists, and instructional documents for handling, storage, maintenance, etc., that are of informational interest only to project engineering.

(V) - Quality Verification Documents - This term comprises material test reports, heat treatment charts, welding records, NDE results, performance test reports, etc., which demonstrate or certify conformance to the technical or inspection requirements of the procurement documents.

- 1.0 DRAWINGS (E)
 - 1.1 Outline Dimensions, Services and Foundation/Mounting Details - Drawings providing external envelope, including lugs, center line(s), location and size for electrical cable, conduit, fluid, and other service connections, isometrics, and details related to foundations and mountings.
 - 1.2 Assembly Drawings - Detailed drawings indicating sufficient information to facilitate assembly of the component parts of an equipment item.
 - 1.3 Shop Detail Drawings - Drawings which provide sufficient detail to facilitate the fabrication or manufacture of the equipment item. This includes but is not limited to, spool drawings, heat exchanger internal details, internal piping and wiring, cross-section details and architectural details.
 - 1.4 Wiring Diagrams - Drawings which show the schematic wiring and connection information for electrical items.
 - 1.5 Control Logic Diagrams - Drawings which show the paths which input signals must follow to accomplish the required responses.
 - 1.6 P & IDs - Piping and Instrumentation Diagrams which show piping system details and the basic control elements.
- 2.0 PARTS LIST AND COST (E) - Exploded view with identified parts and recommended spare parts for one year's operation with unit cost.
- 3.0 COMPLETED BECHTEL DATA SHEETS (E) - Information provided by a supplier on data sheets furnished by Bechtel which states serial numbers, operating ranges, etc., of equipment that the supplier intends to deliver to satisfy the specification requirements.
- 4.0 INSTRUCTIONS (E)
 - 4.1 Erection/Installation - Detailed written procedures, instructions, and drawings required to erect or install material or equipment.
 - 4.2 Operating - Detailed written instructions describing how an item or system should be operated.
 - 4.3 Maintenance - Detailed written instructions required to disassemble, reassemble and maintain items or systems in an operating condition.
 - 4.4 Site Storage and Handling - Detailed written instructions which define the requirements and time period, for lubrication, rotation, heating, lifting or other handling requirements to prevent damage or deterioration during storage and handling at jobsite. This includes return shipping instructions.
- 5.0 SCHEDULES, ENGINEERING AND FABRICATION/ERECTION (E) - Bar charts, critical path methods, etc., which chronologically detail the sequence of activities.
- 6.0 QUALITY ASSURANCE MANUAL/PROCEDURES (E) - The document(s) which describe(s) the planned and systematic measures that are used to assure that structures, systems, and components will meet the requirements of the procurement documents.
- 7.0 SEISMIC DATA REPORT (E) - The analytical or test data which provides physical response information on an item, material, component or system in relation to the conditions imposed by the stated seismic criteria.
- 8.0 ANALYSIS AND DESIGN REPORT (E) - The analytical data, (stress, electrical loading, fluid dynamics, etc.), which assures that an item satisfies specified requirements.
- 9.0 ACOUSTIC DATA REPORT (E) - The noise, sound and other vibration data required by specification which is in the audible range and above the seismic frequency.
- 10.0 SAMPLES (E)
 - 10.1 A representative data package which will be submitted for the items purchased as required in the specification.
 - 10.2 A representative example of the material to be used.
- 11.0 MATERIAL DESCRIPTION (E) - The technical data describing a material which a supplier proposes to use for a specific order. This usually applies to architectural items, e.g., metal siding, decking, doors, paints, coatings.
- 12.0 WELDING PROCEDURES AND QUALIFICATIONS (E), AND VERIFICATION REPORTS (V) - The welding procedure specification and supporting welding procedure qualification test records required for welding, hard facing, overlay, brazing and soldering. A verification report of welds performed includes the identification of the qualified welder(s), and the procedure(s) used, and certification that the welder(s) were qualified.
- 13.0 WELD ROD CONTROL PROCEDURES (E), AND VERIFICATION REPORTS (V) - The procedures for controlling issuance, handling, storage and traceability. Verification report(s) for weld rod are defined as certified material test reports which include the requirements defined by the code and material specification imposed by the procurement documents.
- 14.0 REPAIR PROCEDURES (E), AND MAJOR REPAIR VERIFICATION REPORTS (V) - The procedures for controlling material removal and replacement by welding, brazing, etc., subsequent thermal treatments, and final acceptance inspection. Verification reports may include weld repair locations (map(s)), material test reports for filler metal, pre and post-weld heat treatment records, NDE records, etc. The resolution of whether a repair is major or not is a Bechtel responsibility.

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Sheet 3 of 4

Appendix B - Attachments 1

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- 15.0 **CLEANING AND COATING PROCEDURES (E), AND VERIFICATION REPORTS (V)** — The procedures for removal of dirt, grease or other surface contamination and includes application of protective coatings. Verification reports include certification of visual examination for surface preparation, surface profile, materials, etc., humidity data, temperature data and coating thickness data as required by the procurement documents.
- 16.0 **HEAT TREATMENT PROCEDURES (E), AND VERIFICATION REPORTS (V)** — The procedures for controlling temperature, time at temperature as a function of thickness, furnace atmosphere, cooling rate and method, etc. Verification reports normally include furnace charts or similar records which identify and certify the item(s) treated, the procedure used, furnace atmosphere, time at temperature, cooling rate, etc. Verification data may be in either narrative or tabular form.
- 17.0 **CERTIFIED MATERIAL PROPERTY REPORTS (V)**
- 17.1 **MTR (Certified Material Test Reports)** — These reports include all chemical, physical, mechanical and electrical property test data required by the material specification and applicable codes. This is applicable to cement, concrete, metals, cable jacket materials, rebar, rebar splices, etc. The certified MTR shall include a statement of conformance that the material meets the specification requirements.
- 17.2 **Impact Test Data** — Results of all Charpy or drop weight tests including specimen configuration, test temperature and fracture data.
- 17.3 **Ferrite Data** — Report of the ferrite percentage for stainless steel materials used, including castings & welding filler metals as deposited.
- 17.4 **Material Certificate of Compliance** — Verification document which certifies conformance to the requirements of the applicable material specification.
- 17.5 **Electrical Property Reports** — Report of electrical characteristics, e.g., dielectric, impedance, resistance, flame test, corona, etc.
- 18.0 **CODE COMPLIANCE (V)** — Verifying documents (such as data Forms U-1, N-2, State, etc.), which are prepared by the manufacturer or installer and certified by the Authorized Code Inspector.
- 19.0 **UT - ULTRASONIC EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V)** — Method of detection and examination results of presence and certain characteristics of discontinuities and inclusions in materials by the use of high frequency acoustic energy.
- 20.0 **RT - RADIOGRAPHIC EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V)** — Method of detection and examination results of presence and certain characteristics of discontinuities and inclusions in materials by x-ray or gamma-ray exposure of photographic film.
- 21.0 **MT - MAGNETIC PARTICLE EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V)** — Method of detection and examination results of surface (or near surface) discontinuities in magnetic materials by distortion of an applied magnetic field.
- 22.0 **PT - LIQUID PENETRANT EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V)** — Method of detection and examination results of surface discontinuities in materials by application of a penetrating liquid in conjunction with suitable developing techniques.
- 23.0 **EDDY CURRENT EXAMINATION PROCEDURES (E), AND VERIFICATION REPORTS (V)** — Method for detection and examination results of discontinuities in material by distortion of an applied electromagnetic field.
- 24.0 **PRESSURE TEST — HYDRO, AIR, LEAK, BUBBLE OR VACUUM TEST PROCEDURE (E), AND VERIFICATION REPORTS (V)** — Method for evaluating the structural and mechanical adequacy or integrity by application of differential pressures, and report of the test results.
- 25.0 **INSPECTION PROCEDURE (E), AND VERIFICATION REPORTS (V)** — Organized process followed for the purpose of determining that specified requirements (dimensions, properties, performance results, etc.) are met. Documented findings resulting from an inspection are included in the verification report.
- 26.0 **PERFORMANCE TEST PROCEDURES (E), AND VERIFICATION REPORTS (V)** — Tests performed to demonstrate that functional design and operational parameters are met and the report of the test results.
- 26.1 **Mechanical Tests**, e.g., pump curves, valve stroking, load, temperature rise, calibration, environmental, etc.
- 26.2 **Electrical Tests**, e.g., load, impulse, overload, continuity, voltage, temperature rise, calibration, saturation, loss, etc.
- 27.0 **PROTOTYPE TEST REPORT (E & V)** — Report of a test which is performed on a standard or typical example of equipment, material or item, and is not required for each item produced in order to substantiate the acceptability of equal items. This normally includes tests which may, or could be expected to, result in damage to the item(s) tested.
- 28.0 **SUPPLIER SHIPPING PREPARATION PROCEDURE (E)** — The procedure used by a supplier to prepare finished materials or equipment for shipment from his facility to the jobsite.

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1.0 GENERAL

Every effort shall be made to establish locations of embeds prior to placement of concrete. The basic routes of Category I systems (such as piping, cable trays, ducts and conduits) should be laid out early in the design stage to permit the use of embedded items along the routes of these systems. The embeds are to be used to the maximum practicable extent for attaching structural support for items described in Section 2.0.

2.0 APPLICATIONS

2.1 Drilled concrete expansion anchors may be used when other means of providing connections (such as by using embedded plates, shapes or embedded anchors) are not practical due to requirements developed after concrete has been placed or other compelling reasons. Other disciplines should be requested to provide timely information on embedment requirements and make every effort to utilize available embeds and structural steel framing for support connections.

Expansion anchors may be used for attaching the following items as shown in Table 2.1. ASME Section III Classes I, II and III piping and hanger critical shall be as shown on the Piping Class Summary Sheet. The pipe whip restraints shall be as shown on design drawings.

Application	Category	Limitations on Application	Q	I	T	D
Pipe Supports and High Energy Pipe Whip Restraints for the Following Piping Classifications 1) ASME Section III Classes 1,2,3 2) ANSI B31.1.0 3) ANSI B31.1	Q	See Note (1)	Yes	Yes	Yes	
	Hanger Critical and High Energy Pipe Whip Restraints Non-Q	See Note (1)	Yes	Yes	No	
	Other Non-Q					
Supports for Electrical Cable Trays and H&V Ducts	Q	None	Yes	Yes	Yes	
	Non-Q	None	Yes	Yes	No	
Supports for Equipment	Q	Limited to equipment weighing less than 10 kips (2)	Yes	Yes	Yes	
	Non-Q	None	Yes	Yes	No	
Attachment to (Filled) Concrete Block Walls	Q and Non-Q	See Note (3)	Yes	Yes	Yes	
Supports for Structural and Miscellaneous Metal Items Such as Platforms, Ladders, Handrails, Supports of Miscellaneous Electrical and Instrumentation Items	Q	Limited to total load of 10 kips	Yes	Yes	Yes	
	Critical Support (design for seismic loading) Non-Q	None	Yes	Yes	No	
	Other Non-Q except noted below	None	Yes	No	No	
	Applications such as lighting panels, junction boxes, conduit, instrument tubing and inter-communication equipment (See Section 3.2)	None	No	No	No	

ANCHOR DIAMETER INCHES	MIN. EMBED- MENT IN INCHES E	TENSION (T)			SHEAR (S)			MIN. SPACING INCHES (-)
		f'c PSI (3)			f'c PSI (3)			
		(1) 3000	(2) 4000	(2) 5000 or higher	(2) 3000	(2) 4000	(2) 5000 or higher	
1/4	1-1/8	0.25	0.30	0.32	0.30	0.4	0.4	3
3/8	1-5/8	0.5	0.5	0.6	0.8	1.0	1.1	4
1/2	2-1/4	1.0	1.2	1.4	1.3	1.5	1.7	5
5/8	4	2.0	2.0	2.2	2.2	2.2	2.4	6
	2-3/4	1.6	1.8	1.8	2.2	2.2	2.4	7-1/2
3/4	5	3.0	3.3	3.4	3.0	3.3	3.4	
	3-1/4	2.4	2.7	2.7	3.0	3.3	3.4	
7/8	5-1/2	3.5	4.0	4.5	4.0	4.0	4.5	9
	4	3.0	3.4	3.4	4.0	4.0	4.5	
1	6	4.0	4.8	5.6	5.0	5.0	5.6	10
	4-1/2	3.6	4.1	4.1	5.0	5.0	5.6	

- (1) From data letter ID-C-145B dated 1/27/76 and draft of design guide 2.xx dated May 3, 1977
- (2) Values based on manufacturer's data

- (3) Concrete strength in psi
- (4) The minimum spacing and min. edge distance may be reduced 50% with an equal reduction in allowable load.

- 3.2 Expansion anchors shall be not less than 1/2-inch diameter for all pipe supports. 1/4-inch and 3/8-inch diameter expansion bolts may be used for attachment of conduits, instrumentation or similar installations.
- 3.3 A minimum of two and a maximum of eight expansion anchors shall be used at each attachment, except that one anchor may be used for connecting conduit clamps or for similar installations. Only 2/3 of allowable design loads shall be used for anchors with single application.
- 3.4 Use 50% of allowable design load values when designing for seismic loads for pipe supports and pipe whip restraints.
- 3.5 When an anchor is subjected to both tension and shear loads, the loads may be combined vectorially $\sqrt{(S^2 + T^2)}$, and use allowable load for tension.
- 3.6 Expansion anchors shall not be used in those areas where rebars required for structural reasons are in a congested pattern, for example in beam soffits, beam strips in slabs, columns, etc. However, 1/4-inch diameter bolts with an embedment depth of 1-1/4-inch or smaller may be used in columns and vertical faces of reinforced concrete beams provided the rebar cover is 1-1/2-inch or more. These cases shall be reviewed by project engineering on a case by case basis.

3.8 Expansion anchors shall not be used for attachment to the metal deck except as noted below:

- a) When there is no other acceptable method of attachment possible, expansion anchors can be used for connection to the metal deck as approved by the project engineer/contractor. The anchors shall be located as shown below in Figure 1. (Use alternate Figure 1, if applicable.)

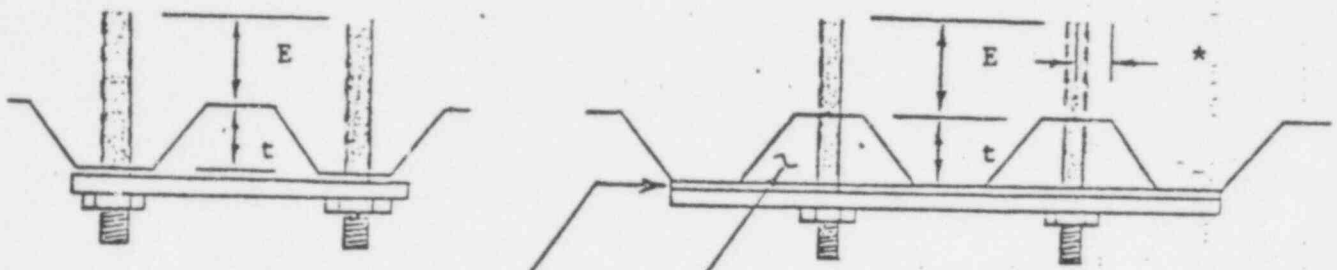


Figure 1

20 gage steel cut and bent in field to suit steel deck

Alternate Figure 1

Valley of deck filled with dry pack grout

*dimension varies

For Q-listed anchors, the installation of dry pack grout is Q-listed.

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TABLE 3.2

Allowable Design Loads (Kips)
 (For HILTI Drop-in Anchors Only)

Anchor Diameter (Inches)	Minimum Embedment (Inches)	Tension (T) f _c psi (2)			Shear (S) f _c psi (2)			Minimum Center-to-Center Spacing (Inches) (3)	Minimum Edge Distance (Inches) (3)	Test Load (Kips)	When HILTI Drop-in Anchors Are Used for the Same C-to-C Spacing as Stud Anchors, Reduce Capacity By:
		3,000 (1)	4,000 (1)	5,000 or Higher (1)	3,000 (1)	4,000 (1)	5,000 or Higher (1)				
1/4	1	0.4	0.45	0.5	0.35	0.35	0.5	3-3/4	2	1.0	20%
3/8	1-5/8	0.8	1.0	1.05	0.80	0.85	1.0	5	2-1/2	2.0	20%
1/2	2	1.05	1.35	1.70	1.20	1.25	1.6	6-1/4	3-1/4	2.5	20%
5/8	2-5/8	1.5	1.90	2.00	2.10	2.45	2.6	8-1/2	4-1/4	4.0	30%
3/4	3-1/4	2.5	3.20	3.25	3.30	3.50	3.9	10	5	6.0	25%

(1) Values based on manufacturer's data.

(2) Concrete strength in psi

(3) Minimum spacing and minimum edge distance may be reduced 50% with an equal reduction in allowable load with prior approval from project engineering

(4) See section 2.2 of Specification C-305.

(1) In this classification, expansion anchors can be used for all piping supports where the load does not exceed 15 kips per hanger except as noted below:

- (a) Expansion anchors shall not be used for Class I piping over 2-1/2" in diameter.
- (b) Expansion anchors shall not be used for Class II piping over 8" in diameter.
- (c) Expansion anchors shall not be used for piping systems and anchor points as listed in Appendix D.

(2) Expansion anchors shall not be used for reciprocating equipment.

(3) Expansion anchors shall not be used to attach Q items and piping to block walls. Use of expansion anchors on concrete filled block walls shall be limited to supporting light loads for non-Q electrical, mechanical, architectural or instrumentation applications.

Any deviation from the use of expansion anchors described above must be approved by the Project Engineer/Contractor on a case by case basis. Any conflict between this specification and hanger detail drawings shall be referred to the Project Engineer/Contractor for resolution.



3.0 DESIGN

3.1 The following criteria (Table 3.1 and 3.2) should be used in the design:



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The following piping shall not be supported by expansion anchors:

1. Pressurizer Relief
 - 4"-2ECD-5
 - 6"-2ECD-6
 - 6"-2ECD-7
 - 14"-2ECD-5
 - 4"-1ECD-5
 - 6"-1ECD-6
 - 6"-1ECD-7
 - 14"-1ECD-5

2. Pressurizer Spray
 - 2½"-2CCA-15-
 - ½"-2CCA-15
 - 4"-2CCA-15
 - 2½"-1CCA-15-
 - ½"-1CCA-15
 - 4"-1CCA-15

3. Makeup and Purification
 - 1½"-2HCC-35
 - 1½"-2CCC-3
 - 2½"-2CCB-12
 - 2½"-2CCB-2
 - 2½"-2CCB-8
 - 1½"-1HCC-35
 - 1½"-1CCB-3
 - 2½"-1CCB-12
 - 2½"-1CCB-2
 - 2½"-1CCB-8

4. Service Water
 - The first two supports on inlet and outlet of auxiliary building chillers on following lines:
 - 6"-1HBC-304
 - 6"-1HBC-305
 - 6"-2HBC-304
 - 6"-2HBC-305
 - 6"-1HBC-307
 - 6"-1HBC-308
 - 6"-2HBC-307
 - 6"-2HBC-308

5. Chilled Water
 - The first two supports on inlet and outlet of chillers on following lines:
 - 4"-1HEC-348
 - 4"-1HEC-216
 - 4"-1HEC-235
 - 4"-1HBC-218
 - 4"-2HBC-233
 - 4"-2HBC-216-
 - 4"-2HBC-235
 - 4"-2HBC-218

FOR

LIMITATIONS ON

INSTALLING GROUTED ANCHOR BOLTS,

EXPANSION ANCHOR BOLTS, AND/OR REINFORCING STEEL

IN

CONCRETE STRUCTURES

1.0 GENERAL CRITERIA

- 1.1 This specification shall apply to the installation of all grouted and or expansion anchors and reinforcing steel in Q-listed structures.
- 1.2 Reinforcing bars shall not be cut in the following structural elements without project engineering or resident engineering approval.
 - 1.2.1 Containment shell
 - 1.2.2 Reinforcing steel in the near face of steel lined surfaces (i.e., spent fuel pool, sumps, etc.)
 - 1.2.3 Columns, beams pilasters or areas of congested reinforcing (main bars less than 6" apart)
 - 1.2.4 Bundled bars (not including replacement steel) and #14 and #18 bars
- 1.3 Pachometer, ferrometer or equal rebar locator shall be used to facilitate location of rebar prior to drilling holes in the concrete.
- 1.4 Relocation of anchor plates shall be as allowed by applicable discipline specification.
- 1.5 When an expansion anchor hole is abandoned the new hole can be drilled at a minimum distance of two (2) times the diameter of the hole provided the abandoned hole is repaired in accordance with Section 17 of Specification 7220-C-231 prior to application of load on the anchor. Installation of anchor does not constitute loading the anchor. All abandoned holes shall be repaired prior to application of load.

7. Reactor building spray system between the spray nozzles
and the steam lines to the auxiliary feed pump turbine.

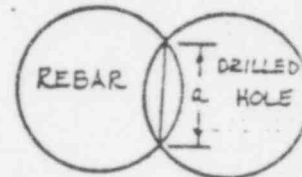
D-2

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In the event it is necessary to cut reinforcing bars in a slab or wall or unless otherwise noted on the drawings, the reinforcing cutting allowance without prior project engineering approval shall meet the following criteria:

- 2.1 One bar may be cut each way each face. The minimum radial distance to the next cut bar on the same face in the same direction shall be five (5) feet.
- 2.2 In lieu of Section 2.1 above, two bars may be cut each way, each face, provided the minimum radial distance to the next cut bar on the same face in the same direction shall be ten (10) feet.
- 2.3 Not more than two (2) bars shall be cut each way each face per anchor plate location.
- 2.4 Multicutting of the same rebar may be counted as one cut.
- 2.5 Cutting of deformation does not constitute a cut bar. A bar shall be considered a cut bar if the chord distance along the cut is greater than 1/2 the diameter of the bar.

<u>BAR SIZE</u>	<u>CHORD DISTANCE ALONG THE CUT (a)</u>
Ø4	1/4"
Ø5	5/16"
Ø6	3/8"
Ø7	7/16"
Ø8	1/2"
Ø9	9/16"
Ø10	5/8"
Ø11	11/16"
Ø14	7/8"
Ø18	9/8"



- 2.6 In the event the foregoing requirements are to be exceeded, prior approval of Project Engineering or the Resident Engineer is required.

3.0 DOCUMENTATION

All reinforcing cuts in accordance with Section 2.0 shall be recorded and transmitted to project engineering for review within 30 days after the bar is cut. The following information shall be supplied:

- a. Building
- b. Room and wall or slab identification
- c. Deleted.
- d. Near or far face

g. Location of cut with respect to elevation and column lines.

In the event the review shows any design deficiency, modification shall be carried out in the affected area as directed by project engineering.

To R. L. Castleberry
 Subject Job 7220 Midland Project
 Hilti Expansion Type Concrete Anchor Bolt
 Torque Verification Tests
 BCBE-895
 Copies to D. T. Bailey (SFHO)

Date August 1968

CS	
CIVIL	<input checked="" type="checkbox"/>
ASCH	
CONSTRUCTION	
C. T. J. G. P. L.	
J. O. J. G. P.	
Midland, Michigan	
FIELD	
CONST. COORD.	
FRAB	

In accordance with specification 7220-C-305, Table 4.1, the field conducted tests on Hilti "Kwik Bolts" to determine the actual range of torque values for the different concrete strengths used on the Midland Project.

C-305 PR

The tests were conducted in the following manner:

1. Three (3) each of the following size anchor bolts; one-half inch (1/2"), five-eighths inch (5/8"), three-quarter inch (3/4"), and one inch (1"), were installed in a three thousand pound (3000 Lb) concrete mix to the minimum embedment required by specification 7220-C-305, Table 4.1.
2. A plate was set over the bolt and the washer and nut were screwed onto the bolt finger tight. The nut was then torqued to the minimum value shown in specification 7220-C-305, Table 4.1. The number of turns of the nut required to reach the torque value was counted.
3. A machine (see sketch attached) was placed over each bolt and the test load prescribed by specification 7220-C-305, Table 4.1 was applied and held for two (2) minutes. If, after two (2) minutes, the washer could not be moved, the torque value was considered to be satisfactory for a minimum value. If the washer could be moved, the nut was torqued to a higher value determined by the slippage on the bolt. For example, if the bolt slipped before the test load was fully applied, the torque value was raised twenty (20) foot pounds. If the bolt slipped during the two (2) minute holding period, the torque value was raised ten (10) foot pounds. At all times the number of turns applied to each nut was noted. If the bolt ran out of thread, a new set of three (3) bolts of the size being tested were installed and the tests continued until all three (3) bolts held at the same torque value.
4. After the minimum torque value was determined, the one-half inch (1/2"), five-eighths inch (5/8"), and three-quarter inch (3/4") bolts were then given an additional test to determine their absolute load at that torque value. If the absolute load was at

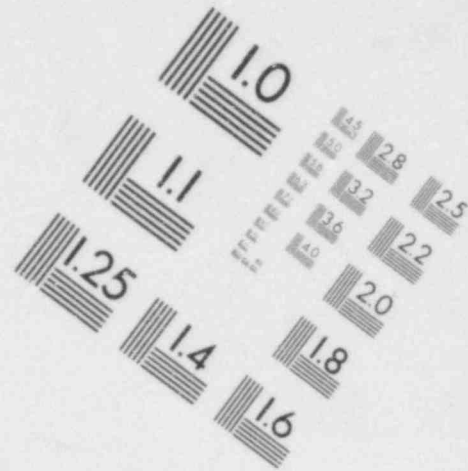
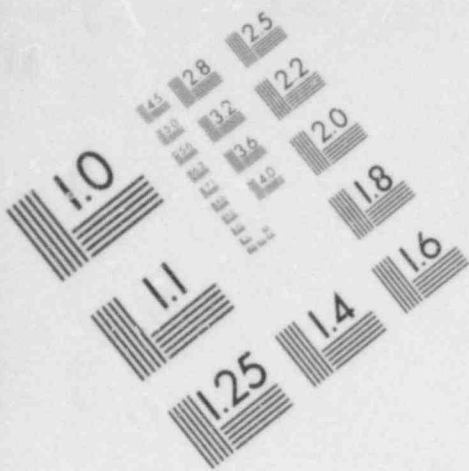
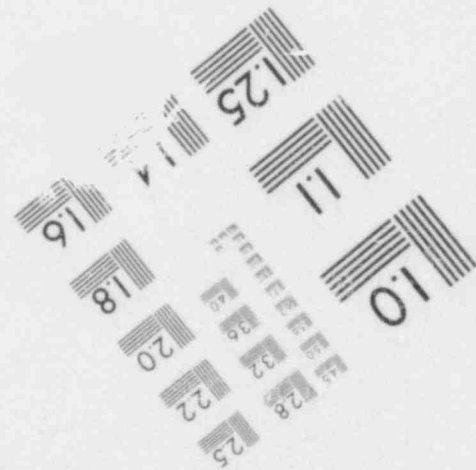
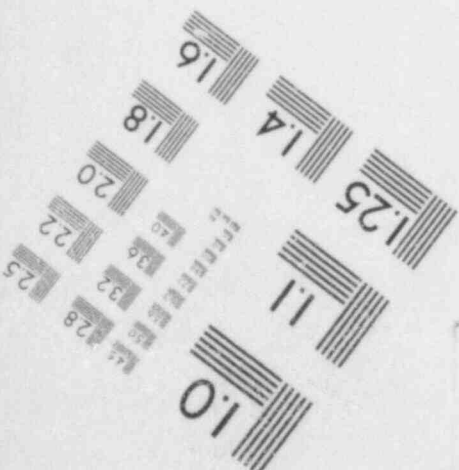
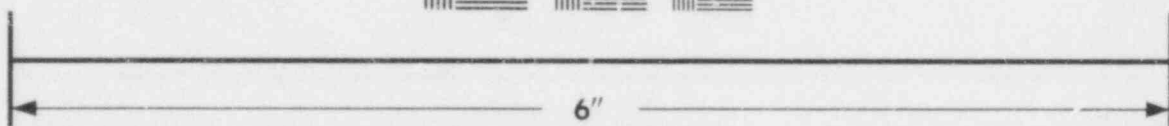


IMAGE EVALUATION
TEST TARGET (MT-3)



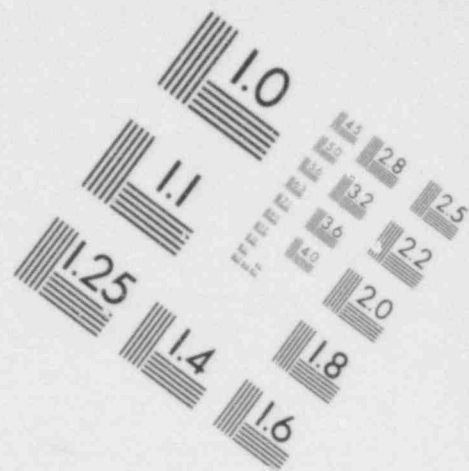
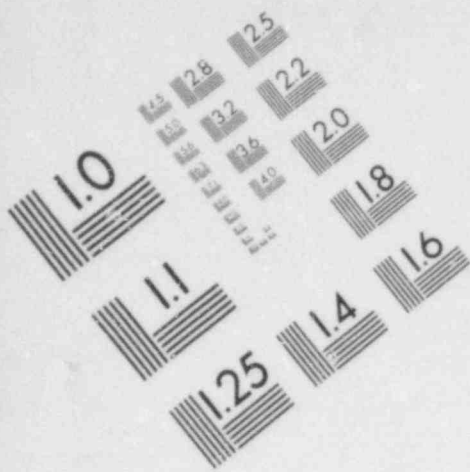
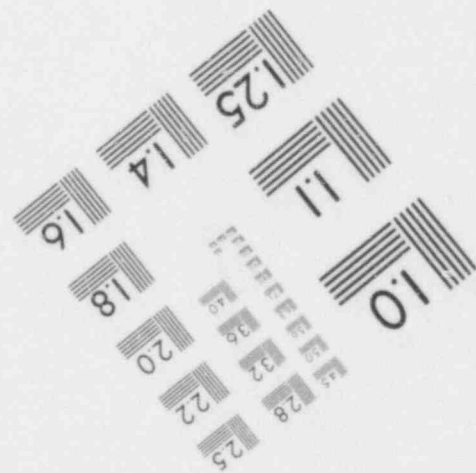
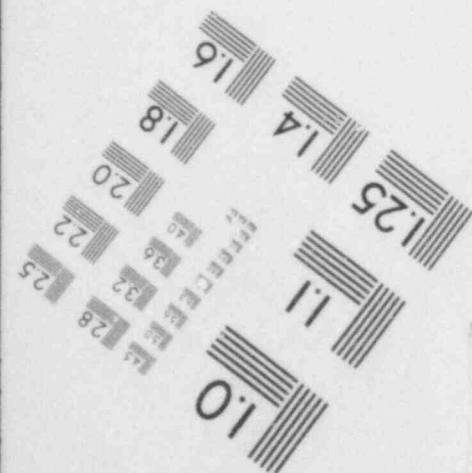
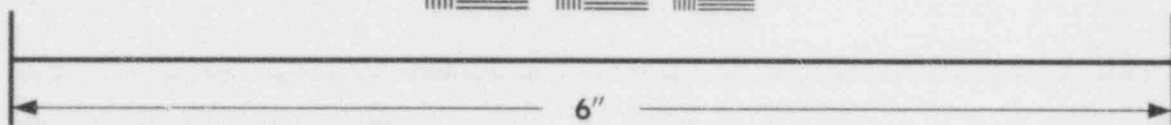


IMAGE EVALUATION
TEST TARGET (MT-3)



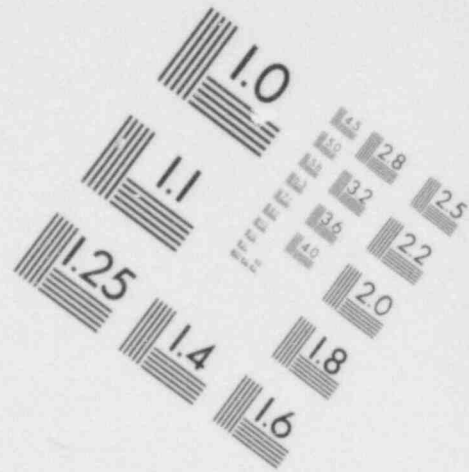
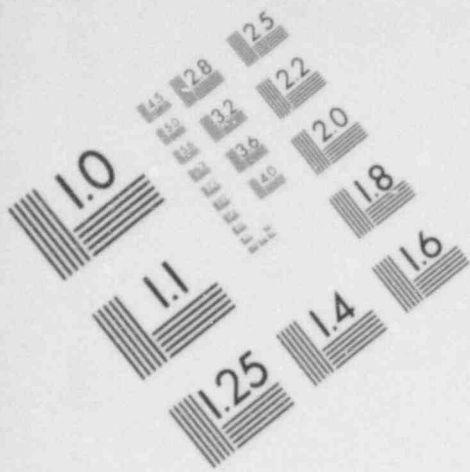
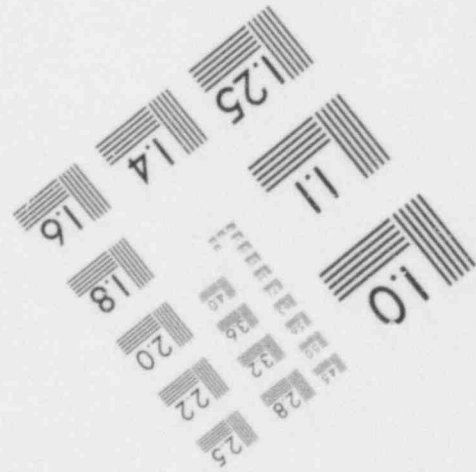
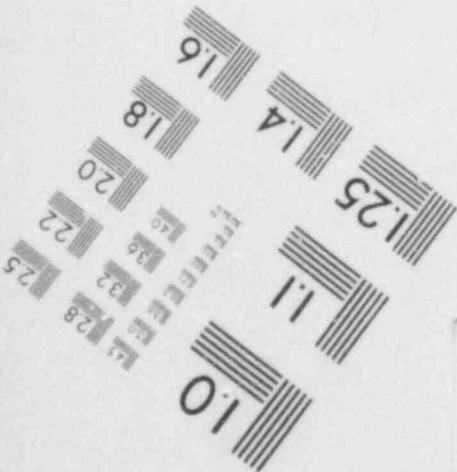
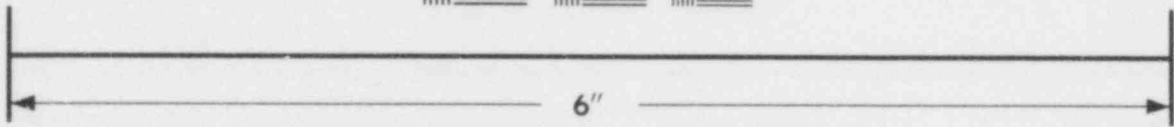
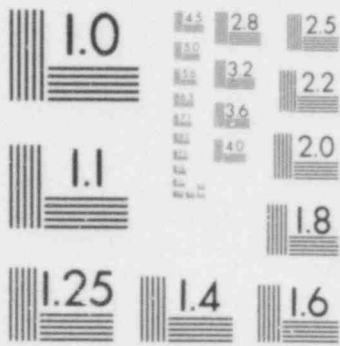


IMAGE EVALUATION
TEST TARGET (MT-3)



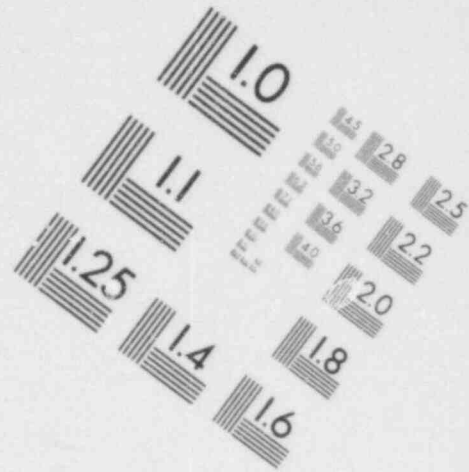
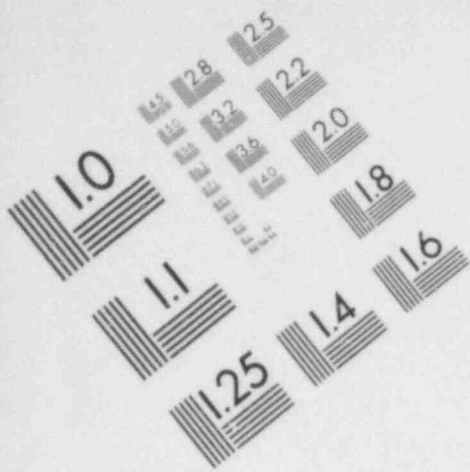
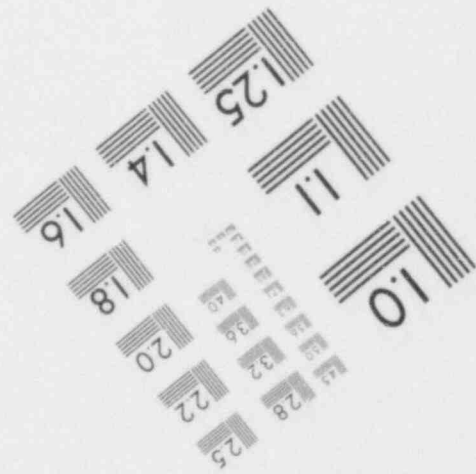
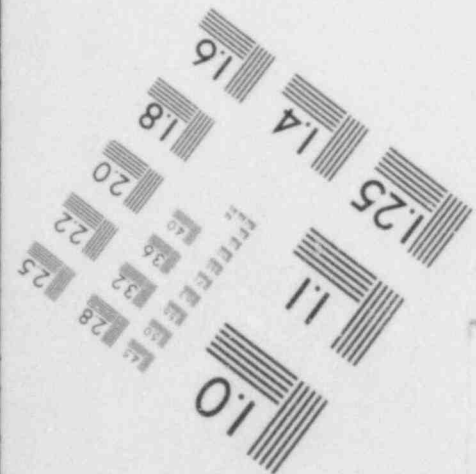
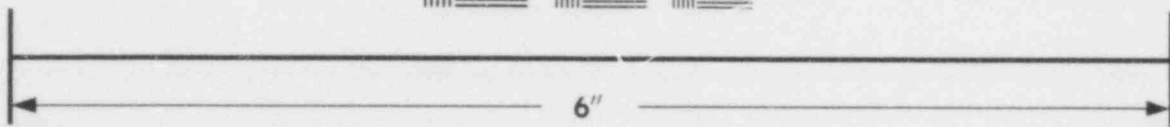
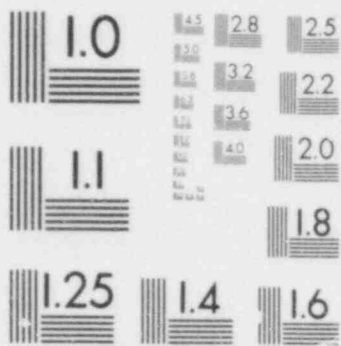


IMAGE EVALUATION
TEST TARGET (MT-3)



this was considered to be proof of the minimum torque value. The one inch (1") bolts were not given this absolute test because the test apparatus could not measure a load greater than 8.283 KIPS.

5. The bolts that were used to produce satisfactory minimum torque values were then retorqued to a higher value and retested to prove they would not slip when the test loads were again applied. The higher torque value was determined by: 1) What the field considered to be a satisfactory working spread between minimum and maximum torque values, and 2) The highest value the Hilti representatives would allow on the bolts due to their safety factors.
6. The minimum and maximum torque values arrived at for the 3000 pound concrete mix were as follows:
 - 1/2" bolt = 25 foot pounds to 45 foot pounds
 - 5/8" bolt = 120 foot pounds to 150 foot pounds
 - 3/4" bolt = 220 foot pounds to 250 foot pounds
 - 1" bolt = 425 foot pounds to 475 foot pounds
7. Proof tests were then conducted in the 4000 pound and 5000 pound concrete strengths to verify the torque values were acceptable in the higher strength concretes. Some adjustments were made to the minimum torque values to make them satisfactory in the higher strength concrete. The maximum values were also adjusted to keep the same spread between the minimum and maximum torque values. The new values were slightly higher but were not retested in the 3000 pound mix since the torque values were considered to be minimum when arrived at in that test.

The final values are as follows:

- 1/2" bolt = 35 foot pounds to 55 foot pounds
- 5/8" bolt = 130 foot pounds to 160 foot pounds
- 3/4" bolt = 240 foot pounds to 270 foot pounds
- 1" bolt = 425 foot pounds to 475 foot pounds

During the proof tests for the torque range to be used for the installation of the Hilti "Kwik Bolts", the number of turns on the nut required to obtain the minimum torque value became a significant item. If the minimum torque was obtained before a certain number of turns of the nut were made, the chances of the bolt slipping was about 30%. If more turns were required to obtain the minimum torque value, no slip occurred. Based upon observations made during the testing, it became apparent that even though the minimum torque values were reached with less turns, torquing of the bolts should continue until at least 2 complete turns of the nuts have been made on the one-half (1/2") inch and five-eighths inch (5/8") bolts and at least 3 complete turns of the nuts have been made on the three-quarter inch (3/4") and one inch (1") bolts.

completed, and torque range should be
securely at the maximum torque value.

The above tests were conducted by Bechtel craftsmen at the Midland Project Job 7220 under direction of Bechtel field engineering. The initial tests in the 3000 pound concrete were witnessed by R. K. Burket, F. Studer, G. McKindles, and P. Halarkey of Hilti, Inc. The initial test in the 3000 pound concrete was conducted on July 28 and July 29, 1976, and the verification tests in the 4000 pound and 5000 pound concrete were conducted on July 30, 1976.

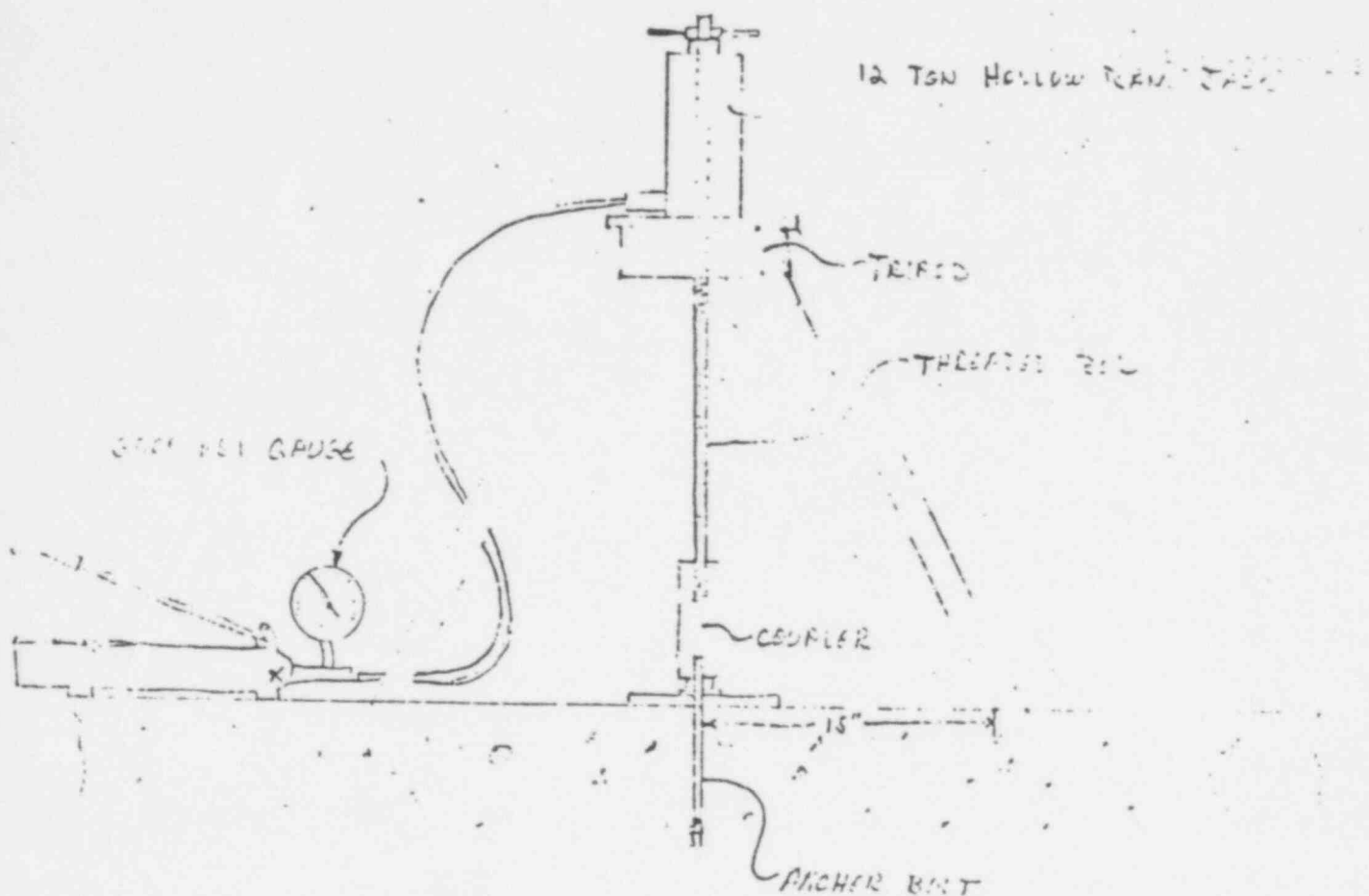
An FCR to specification 7220-C-305 will be submitted to change Table 4.1 to reflect the results of the above tests.

If you have any questions on the above subject, please contact Ron Hendricks at the Midland Jobsite.

C. H. Newgen
for J. F. Newgen

JFN/RII/jrh

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POOR ORIGINAL

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